The impact of future vehicles on pollutant emissions and air quality in Europe

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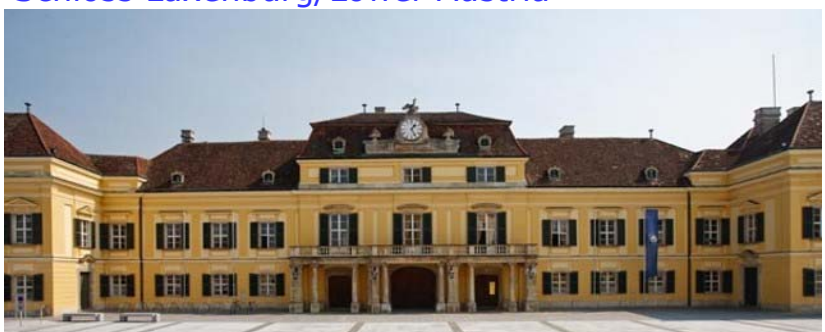
Schloss Laxenburg/Lower Austria



What is IIASA?
IIASA is an international scientific institute that conducts policy-oriented research into problems too large or too complex to be solved by a single country, founded in 1972.

"Who" is IIASA?
Nearly 200 natural and social scientists, mathematicians, and engineers from over 35 countries research at IIASA.

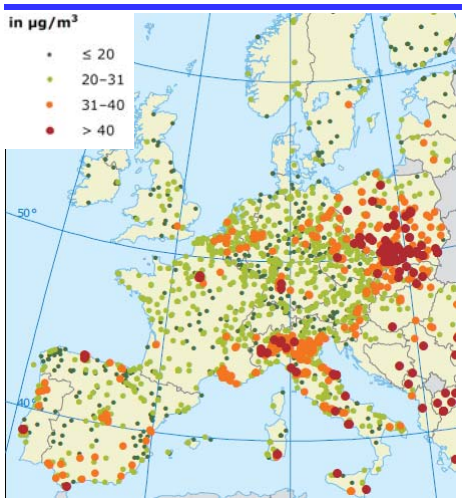
Widespread air quality problems in Europe

Pollutant	EU reference value	Exposure estimate (%)	WHO reference level	Exposure estimate (%)
$PM_{2.5}$	Year (20)	16–30	Year (10)	90–95
PM_{10}	Day (50)	18–21	Year (20)	80–81
O_3	8-hour (120)	15–17	8-hour (100)	> 97
NO_2	Year (40)	6–12	Year (40)	6–12
BaP	Year (1 ng/m³)	20–29	Year (0.12 ng/m³)	93–94
SO_2	Day (125)	< 1	Day (20)	58–61
CO	8-hour (10 mg/m³)	0–2	8-hour (10 mg/m³)	0–2
Pb	Year (0.5)	< 1	Year (0.5)	< 1
C_6H_6	Year (5)	< 1	Year (1.7)	7–8

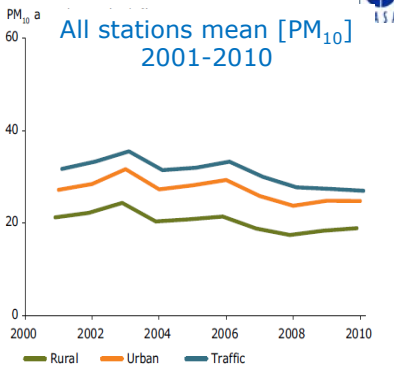
EEA 2012 – Air quality in Europe

- How big is contribution from road vehicles – now and in future?
- Possible improvement through alternative fuels or vehicles?

PM_{10} and $PM_{2.5}$ limits exceeded – not only at traffic sites



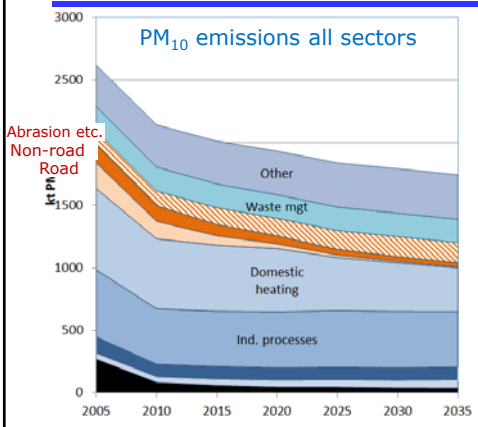
EEA 2012 – Air quality in Europe



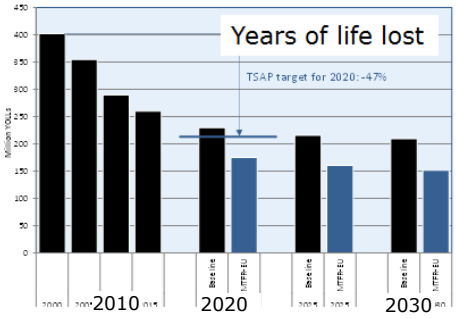
All stations mean [PM_{10}] 2001-2010

Limit value for protection of human health: 40 µm/m³ annual average, not to be exceeded .

Trend development of PM_{10} emissions and their health impact in EU27



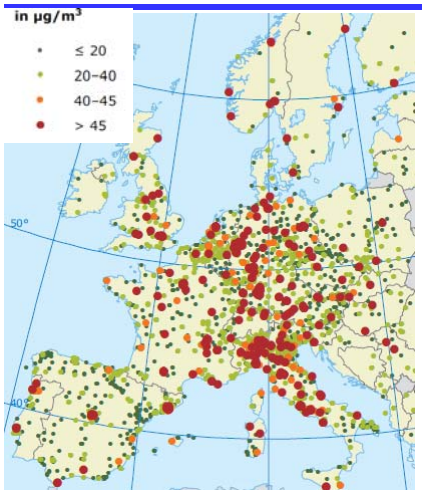
Low share of emissions from road vehicles, declining.



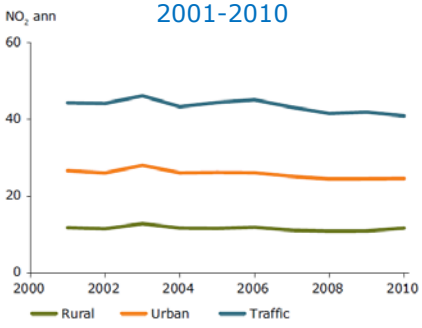
Environmental objective could be met in 2020 with additional measures – yet little progress beyond.

IIASA 2012 – gains.iiasa.ac.at/TSAP

NO_2 limit values exceeded – particularly at traffic sites

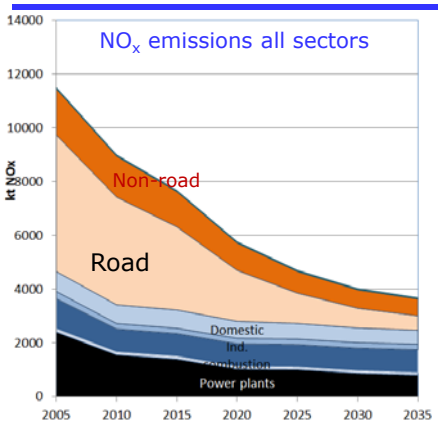


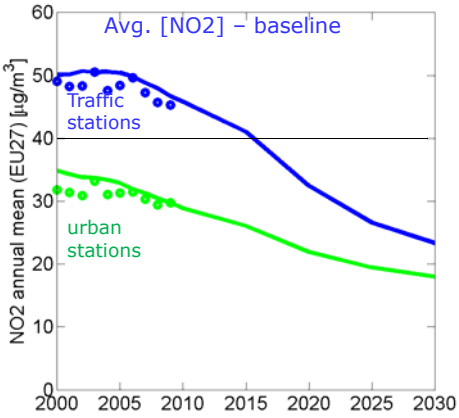
EEA 2012 – Air quality in Europe



Limit value for protection of human health: 40 µm/m³ annual average.

Trend development of NO_x emissions and exceedance of $[NO_2]$ limit values in EU27





High share of traffic emissions, declining

Exceedance at traffic stations strongly declining…. **IF….**

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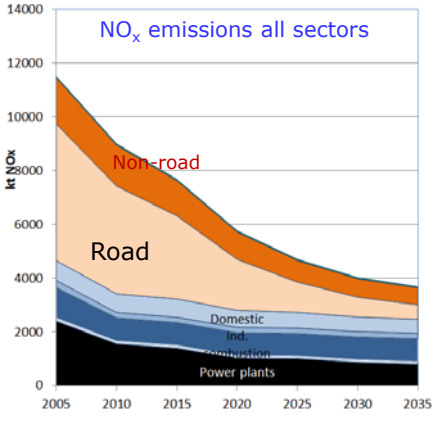
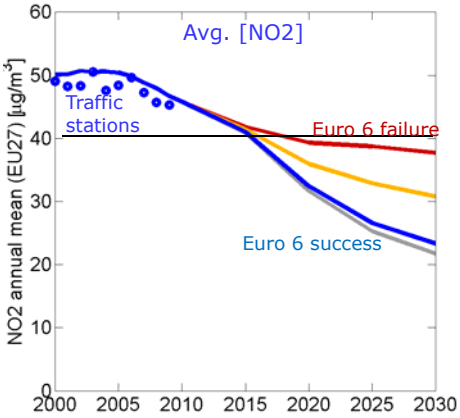
Trend development of NO_x emissions and exceedance of $[NO_2]$ limit values in EU27





High share of traffic emissions, declining

Exceedance at traffic stations strongly declining…. **IF EURO 6 diesel cars have lower unit NOx emissions.**

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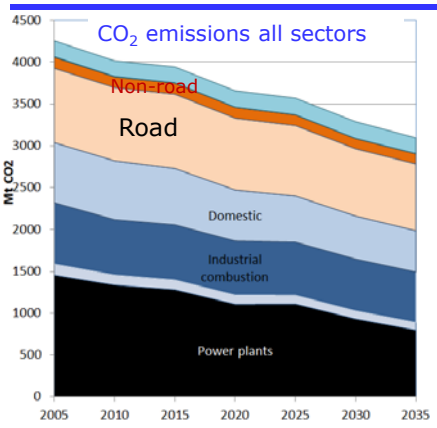
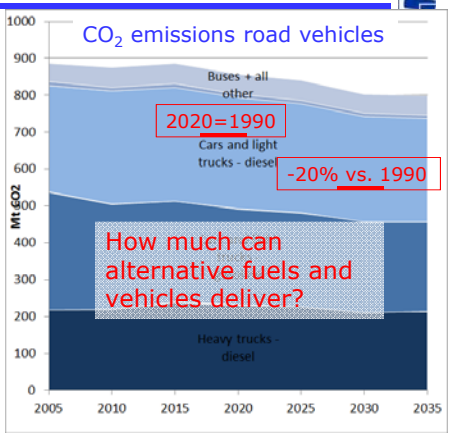
Trend development of CO_2 emissions in EU27





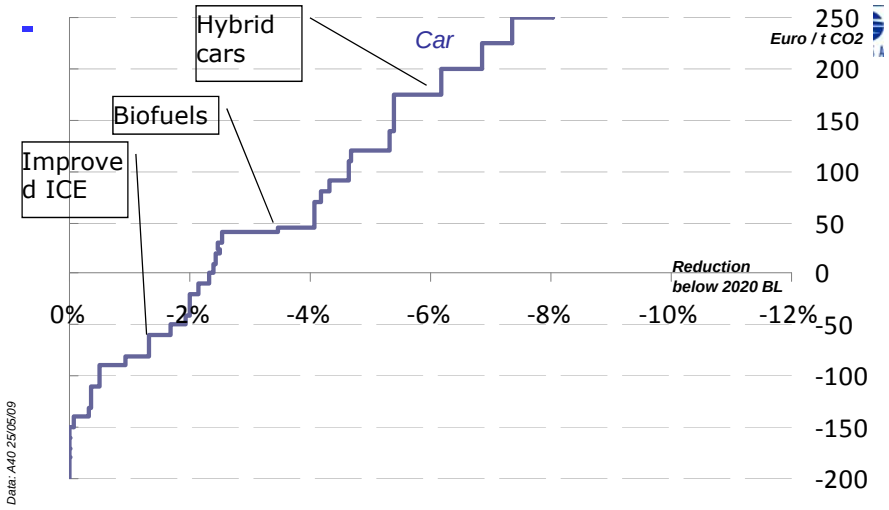
IIASA 2012 – gains.iiasa.ac.at/TSAP

Official EC projection:
Trend 2020: -14% vs. 2005
Share road in total emissions: 22%

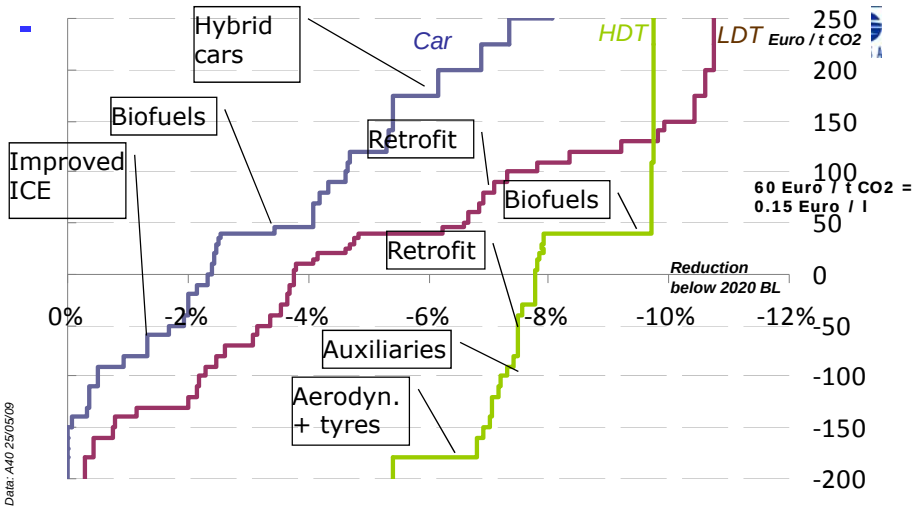
Trend 2030: -3% vs. 2005
Share cars/trucks in total road : 55%/25%

Cost curve: By vehicle type - EU27 in 2020

(lifetime payback, GHG)



Abatement for road vehicles - EU27 in 2020
(lifetime payback, GHG)



Borken-Kleefeld et al. 2009, data need update, but ranking indicative.

Summary

Strongly declining pollutant emissions from national road transport, yet
- NO_2 compliance depends on effectiveness of EURO 6 for diesel cars.
- Local conditions might differ from national average.

Zero-emission vehicles might help in specific cases, also reducing traffic noise.

For CO_2 reduction intensified efforts needed:
- Much more efficient conventional **and** alternative vehicles **and**
- Sustainable low-C fuels **and**
- Adapted driving and purchase behaviour **and**
- Improved freight logistics **and**
- Modal shift **and**
- Adapted land use planning **and**
- Demand management **and**…

Not addressed:
Accidents, congestion, landscape fragmentation, resource infrastructure financing,…

Further reading

Reports and calculations on the
EU's Thematic Strategy on Air Pollution
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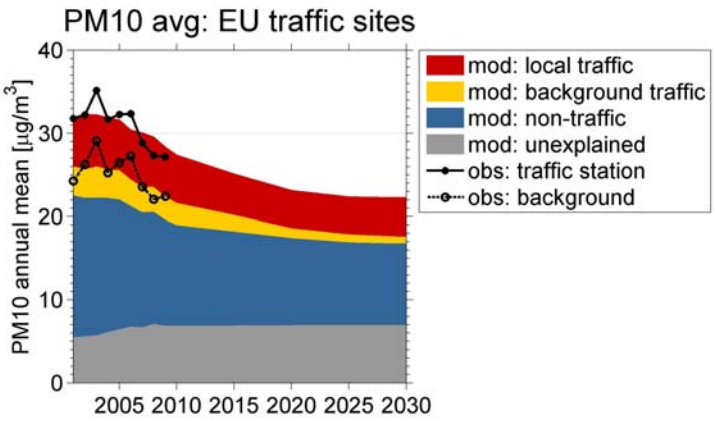
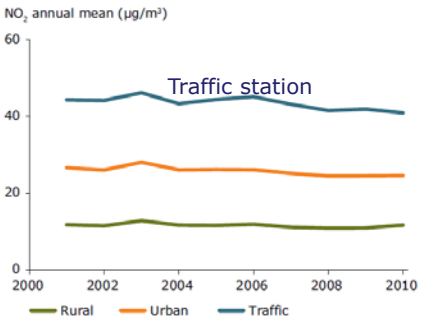
Contribution of local & urban road traffic to [PM10]



Problems linked to traffic & light duty diesel vehicles

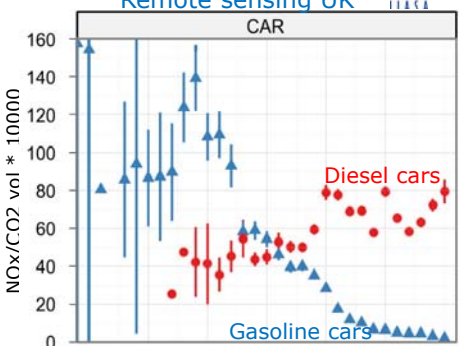
Mean [NO2] 2001-2010



NO2 limit values exceeded almost only at traffic stations – persistent over the years

EEA 2012 – Air quality in Europe

Remote sensing UK



Year manufactured 1980 -2010

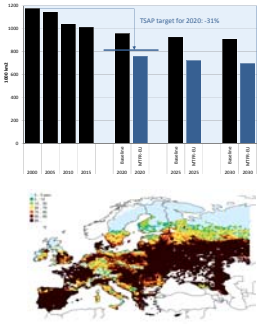
NOx unit emissions from diesel cars increased in real driving

Carslaw et al. (AE 2011)

Ecosystems impacts

Results

Eutrophication (unprotected area)



% of unprotected ecosystems area

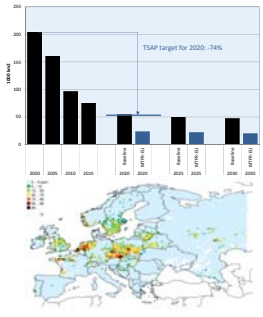
Baseline leaves biodiversity unprotected at 950,000 km² (55%) of all ecosystems area

MTFR measures could provide protection to another 200,000 km² after 2020

Soil acidification will remain a threat to 50,000 km² (~4%) of European forests.

MTFR measures could protect another 30,000 km²

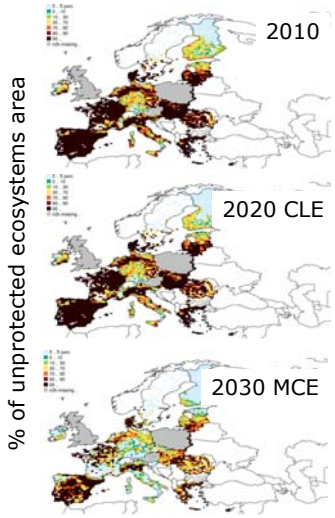
Acidification (unprotected forest area)



% of unprotected forest area

Natura2000 areas

Threat to biodiversity from excess nitrogen input



- Nitrogen input will continue to threaten biodiversity at about two thirds (350,000 km^2) of these nature protection zones in the baseline case.
- MTFR measures could provide protection to another 100,000 km^2 after 2020
- An incomplete assessment, as not all countries have reported critical load data for Natura2000 areas

Compliance with NO_2 AQ limit values

Methodology